PERGAMON

Microelectronics Reliability 39 (1999) 1885–1898

MICROELECTRONICS RELIABILITY

www.elsevier.com/locate/microrel

Contents of Volume 39

NUMBER 1

N. D. Stojadinović and M. G. Pecht	1	Editorial
		Introductory Invited Paper
A. H. Edwards and W. Beall Fowler	3	Recent advances in the theory of oxide–semiconductor interfaces
		Research Papers
Y. F. Hsieh, Y. C. Hwang, J. M. Fu, Y. M. Tsou, Y. C. Peng and L. J. Chen	15	Dislocation multiplication inside contact holes
J-M. Dilhac, L. Cornibert and C. Ganibal	23	Al thermomigration applied to the formation of deep junctions for power device insulation
J. H. Chun, B. H. Lee, D. S. Byeon, D. Y. Kim, M. K. Han and Y. I. Choi	29	An insulated gate bipolar transistor employing the plugged n^- anode
A. Bravaix, D. Goguenheim, N. Revil, E. Vincent, M. Varrot and P. Mortini	35	Analysis of high temperature effects on performances and hot-carrier degradation in DC/AC stressed 0.35 μm n-MOSFETs
L. Mariucci, A. Pecora, S. Giovannini, R. Carluccio, F. Massussi and G. Fortunato	45	Hot carrier effects in polycrystalline silicon thin-film transistors: analysis of electrical characteristics and noise performance modifications
T.-H. Ihn, T.-K. Kim, B.-Il Lee and S. K. Joo	53	A study on the leakage current of poly-Si TFTs fabricated by metal induced lateral crystallization
S. Bothra, H. Sur and V. Liang	59	A new failure mechanism by corrosion of tungsten in a tungsten plug process
J. K. Mun, C.-H. Kim, J. J. Lee and K.-E. Pyun	69	Failure analysis for RF characteristics of GaAs MESFETs
B. Krabbenborg	77	High current bond design rules based on bond pad degradation and fusing of the wire
V. Székely, M. Rencz and B. Courtois	89	A step forward in the transient thermal characterization of chips and packages
C. Lee, R. Gopalakrishnan, K. Nyunt, A. Wong, R. C.-E. Tan and J. W.-L. Ong	97	Plasma cleaning of plastic ball grid array package
R. Ghaffarian and N. P. Kim	107	Ball grid array reliability assessment for aerospace applications
E. Nicewarner	113	Interconnect resistance characteristics of several flip-chip bumping and assembly techniques
J. Naderman and R. T. H. Rongen	123	Thermal resistance degradation of surface mounted power devices during thermal cycling

0026-2714/99/$ - see front matter. © 1999 Elsevier Science Ltd. All rights reserved.

Research Notes

V. S. Pershenkov, V. V. Belyakov, S. V. Cherepko, I. N. Shvetzov-Shilovsky and V. V. Abramov — 133 Investigation of MOSFET operation in bipolar mode

M. A. Rosa, S. Dimitrijev and H. B. Harrison — 139 Avoidance of stiction in the release of highly boron doped micro-actuators fabricated using BESOI substrates

143 List of reviewers

145 Book reviews

151 Calendar of forthcoming events

NUMBER 2

SPECIAL ISSUE
DIELECTRICS IN MICROELECTRONICS

G. Sarrabayrouse — 159 Guest Editorial

SECTION I: ELECTRICAL PROPERTIES AND RELIABILITY OF INSULATING LAYERS

E. Miranda, J. Suñé, R. Rodríguez, M. Nafría and X. Aymerich — 161 Switching events in the soft breakdown I–t characteristic of ultra-thin SiO_2 layers

D. Goguenheim, A. Bravaix, D. Vuillaume, F. Mondon, Ph. Candelier, M. Jourdain and A. Meinertzhagen — 165 Experimental study of the quasi-breakdown failure mechanism in 4.5 nm-thick SiO_2 oxides

J. C. Jackson, Ö. Oralkan, D. J. Dumin and G. A. Brown — 171 Electric breakdowns and breakdown mechanisms in ultra-thin silicon oxides

P. Bellutti, N. Zorzi and G. Verzellesi — 181 Gate oxide reliability improvement related to dry local oxidation of silicon

P. Temple-Boyer, F. Olivié, E. Scheid, G. Sarrabayrouse, J. L. Alay and J. R. Morante — 187 Breakdown properties of metal/NIDOS SiO_2/silicon structures

A. Meinertzhagen, C. Petit, M. Jourdain, F. Mondon and D. Gogenheim — 191 On positive charge annihilation and stress-induced leakage current decrease

A. Scarpa, B. De Salvo, G. Ghibaudo, G. Pananakakis, A. Paccagnella and G. Ghidini — 197 On the correlation between SILC and hole fluence throughout the oxide

P. Riess, G. Ghibaudo, G. Pananakakis and J. Brini — 203 Measurement and modeling of the annealing kinetics of stress induced leakage current in ultra-thin oxides

S. Bruyère, E. Vincent and G. Ghibaudo — 209 Stress-induced leakage current in very thin dielectric layers: some limitations to reliability extrapolation modeling

A. S. Spinelli, A. L. Lacaita, D. Minelli and G. Ghidini — 215 Analysis of space and energy distribution of stress-induced oxide traps

M. Ceschia, A. Paccagnella, A. Scarpa, A. Cester and G. Ghidini — 221 Total dose dependence of radiation-induced leakage current in ultra-thin gate oxides

A. Candelori, A. Paccagnella, A. Scarpa, G. Ghidini and P. G. Fuochi — 227 Degradation of electron irradiated MOS capacitors

B. De Salvo, G. Ghibaudo, G. Pananakakis and G. Reimbold — 235 ONO and NO interpoly dielectric conduction mechanisms

SECTION II: NON-SILICON-BASED INSULATORS

G. Vélu and G. Rèmiens 241 Dielectric and ferroelectric properties of Perovskite Pb(Zr, Ti)O_3 films deposited by sputtering on Si substrate

C. Legrand, T. Haccart, G. Velu, D. Chambonnet, D. Remiens, L. Burgnies, F. Mehri and J. C. Carru 251 Dielectric characterization of ferroelectric thin films deposited on silicon

C. Schmidt and E. P. Burte 257 MOCVD of ferroelectric thin films

C. Chaneliere, S. Four, J. L. Autran and R. A. B. Devine 261 Comparison between the properties of amorphous and crystalline Ta_2O_5 thin films deposited on Si

J. V. Manca, M. Nesladek, M. Neelen, C. Quaeyhaegens, L. De Schepper and W. De Ceuninck 269 High electrical resistivity of CVD-diamond

SECTION III: INSULATORS TECHNOLOGY, CHARACTERIZATION AND MODELLING

A. Estève, M. D. Rouhani and D. Estève 275 Modelling methodology of silicon oxidation from quantum calculations to Monte Carlo level

A. Courtot-Descharles, F. Pires, P. Paillet and J. L. Leray 279 Density functional theory applied to the calculation of dielectric constant of low-k materials

D. Davazoglou and V. Em. Vamvakas 285 Optical dispersion analysis within the IR range of thermally grown and TEOS deposited SiO_2 films

O. Buiu, S. Taylor, L. Culiuc, M. Gartner and I. Cernica 291 Optical characterization of ion implantation in Si and Si/SiO_2 structures: spectroellipsometric (SE) and second harmonic generation (SHG) results

R. Beyer, H. Burghardt, E. Thomas, R. Reich, D. R. T. Zahn and T. Geßner 297 A study of the interface states in MIS-structures with thin SiO_2 and SiO_xN_y layers using deep level transient spectroscopy

C. Vahlas, V. Em. Vamvakas and D. Davazoglou 303 Low pressure chemical vapor deposition from TEOS–NH_3 mixtures: thermochemical study of the process considering kinetic data

A. J. Bauer, B. Froeschle, M. Beichele and H. Ryssel 311 Characterization of oxide etching and wafer cleaning using vapor phase anhydrous hydrofluoric acid and ozone

F. Qian, G. Temmel, R. Schnupp and H. Ryssel 317 Thin stoichiometric silicon nitride prepared by r.f. reactive sputtering

325 List of reviewers

NUMBER 3

Research Papers

T. Ushiki, M.-C. Yu, K. Kawai, T. Shinohara, K. Ino, M. Morita and T. Ohmi 327 Gate oxide reliability concerns in gate-metal sputtering deposition process: an effect of low-energy large-mass ion bombardment

A. Bandyopadhyay, S. Subramanian, S. Chandrasekhar, A. Dentai and S. M. Goodnick 333 Degradation of InGaAs/InP single heterojunction bipolar transistors under high energy electron irradiation

D. Pogany and G. Guillot 341 Random telegraph signal noise instabilities in lattice-mismatched InGaAs/InP photodiodes

T. Yoshida, S. Hashimoto, Y. Mitsushima, T. Ohwaki and Y. Taga 347 Texture and electromigration lifetime improvements in layered Al-alloy metallization with underlying Ti by controlling water adsorption on SiO_2 substrates

H.-C. Lin, C.-C. Chen, M.-F. Wang, S.-K. Hsien, C.-H. Chien, T.-Y. Huang and C.-Y. Chang 357 Oxide thickness dependence of plasma charging damage

Y. Wu and G. Lucovsky	365	Improvement of gate dielectric reliability for $p+$ poly MOS devices using remote PECVD top nitride deposition on ultra-thin (2.4–6 nm) gate oxides
N. A. Dumin	373	A new algorithm for transforming exponential current ramp breakdown distributions into constant current TDDB space, and the implications for gate oxide Q_{BD} measurement methods
C. T. Tsai and L. L. Liou	383	Dislocation dynamics in heterojunction bipolar transistor under current induced thermal stress
U. Daya Perera	391	Evaluation of reliability of μBGA solder joints through twisting and bending
D. M. Tanner, W. M. Miller, K. A. Peterson, M. T. Dugger, W. P. Eaton, L. W. Irwin, D. C. Senft, N. F. Smith, P. Tangyunyong and S. L. Miller	401	Frequency dependence of the lifetime of a surface micromachined microengine driving a load
M.-D. Ker, T.-Y. Chen and H.-H. Chang	415	New layout design for submicron CMOS output transistors to improve driving capability and ESD robustness
	425	Book reviews
	431	Calendar of forthcoming events

NUMBER 4

		Introductory Invited Paper
S. Dimitrijev, P. Tanner and H. B. Harrison	441	Slow-trap profiling of NO and N_2O nitrided oxides grown on Si and SiC substrates
		Research Papers
C.-H. Jun, Y. Hong, S. Y. Kim, K.-S. Park and H. Park	451	A simulation-based semiconductor chip yield model incorporating a new defect cluster index
P. G. Han, H. Wong and M. C. Poon	457	Physical structure of light-emitting porous polycrystalline silicon thin films
M. Amagai	463	Chip Scale Package (CSP) solder joint reliability and modeling
A. Arshak, D. McDonagh, K. I. Arshak, D. Doyle and I. Harrow	479	Process characterisation of hot-carrier-induced β degradation in bipolar transistors for BiCMOS
M. A. Imam, M. A. Osman and A. A. Osman	487	Threshold voltage model for deep-submicron fully depleted SOI MOSFETs with back gate substrate induced surface potential effects
V. S. Pershenkov, S. V. Cherepko, R. E. Ivanov, A. V. Shalnov and V. V. Abramov	497	Single transistor technique for interface trap density measurement in irradiated MOS devices
S. Domae, R. Eto and K. Okuma	507	Stress-induced voiding in stacked tungsten via structure
L. R. Enlow, D. W. Swanson and C. M. Naito	515	Development of test vehicles for evaluating plastic-encapsulant reliability and improving thermal conductivity of encapsulant materials
L. M. Head and C. Fahrenkrug	529	Voltage transients in electromigration noise measurement data
		Research Notes
R. Balboni, I. de Munari, M. Impronta and A. Scorzoni	537	Additional microstructural analysis on the samples examined in the paper 'Are high resolution resistometric methods really useful for the early detection of electromigration damage?'

K. Takagi 541 A model of 1/f noise spectrum generation in granular structures

545 Book reviews

549 Erratum

NUMBER 5

N. Stojadinović and M. Pecht 551 Editorial

Introductory Invited Papers

C.-Y. Chang, C.-C. Chen, H.-C. Lin, M.-S. Liang, C.-H. Chien and T.-Y. Huang 553 Reliability of ultrathin gate oxides for ULSI devices

D. Park and C. Hu 567 The prospect of process-induced charging damage in future thin gate oxides

J. C. Lee, G. D. Croft, J. J. Liou, W. R. Young and J. Bernier 579 Modeling and measurement approaches for electrostatic discharge in semiconductor devices and ICs: an overview

SPECIAL SECTION: EU RESEARCH PROJECT PROPHECY PAPERS

E. Zanoni 595 Foreword

G. Ghibaudo, G. Pananakakis, R. Kies, E. Vincent and C. Papadas 597 Accelerated dielectric breakdown and wear out standard testing methods and structures for reliability evaluation of thin oxides

A. Scorzoni, M. Impronta, I. De Munari and F. Fantini 615 A proposal for a standard procedure for moderately accelerated electromigration tests on metal lines

N. Kelaidis, A. Scorzoni, M. Impronta and I. De Munari 627 A study of the thermal behavior of different test patterns used in differential high resolution electromigration measurements

G. Meneghesso, E. Zanoni, A. Gerosa, P. Pavan, W. Stadler, K. Esmark and X. Guggenmos 635 Test structures and testing methods for electrostatic discharge: results of PROPHECY project

K. Palser, A. Concannon, R. Duffy and A. Mathewson 647 Analysis of external latch-up protection test structure design using numerical simulation

H. Rempp, O. Thalau, A. Scorzoni, G. Ghilbaudo, E. Vincent and S. Minehane 661 Experiences on reliability simulation in the framework of the PROPHECY project

Research Papers

S. Aur, T. Grider, V. McNeil, T. Holloway and R. Eklund 673 Remote plasma nitridation, deuterium anneal and pocket implant effects on NMOS hot carrier reliability

E. I. Cole Jr, P. Tangyunyong and D. L. Barton 681 Local thermal probing to detect open and shorted IC interconnections

C.-L. Chiang 695 Wafer level backside emission microscopy: dynamics and effects

C.-L. Chiang 709 Wafer level backside emission microscopy: sample preparation

V. A. Gritsenko, Y. G. Shavalgin, P. A. Pundur, H. Wong and W. M. Lau 715 Cathodoluminescence and photoluminescence of amorphous silicon oxynitride

719 Book review

NUMBERS 6–7

SPECIAL ISSUE

RELIABILITY OF ELECTRON DEVICES, FAILURE PHYSICS AND ANALYSIS

Editorial
N. LABAT, A. TOUBOUL ix

TUTORIALS

FLIP-chip and "backside" techniques 721
D.L. BARTON, K. BERNHARD-HÖFER, E.I. COLE JR.

New tools for yield improvement in integrated circuit manufacturing: can they be applied to reliability? 731
C.J. McDONALD

TOPIC A: QUALITY AND RELIABILITY

Invited Paper
Reliability versus yield and die location in advanced VLSI 741
W.C. RIORDAN, R. MILLER, J. HICKS

Junction parameters for silicon devices characterization 751
M. DE LA BARDONNIE, N. TOUFIK, C. SALAMÉ, S. DIB, P. MIALHE, A. HOFFMANN, J.-P. CHARLES

Assessment of worst case dielectric failure rate based on statistical samples with pure intrinsic failure distributions 755
M. KERBER

New rapid method for lifetime determination of gate oxide validated with bipolar/CMOS/DMOS technology 759
X. GAGNARD, M. TAURIN, O. BONNAUD

A universal reliability prediction model for SMD integrated circuits based on field failures 765
G. KERVARREC, M.L. MONFORT, A. RIAUDEL, P.Y. KLIMONDA, J.R. COUDRIN, D. LE RAZAVET, J.Y. BOULAIRE, P. JEANPIERRE, D. PERIE, R. MEISTER, S. CASASSA, J.L. HAUMONT, B. LIAGRE

TOPIC B: MODELLING OF FAILURE MECHANISMS: ESD, ELECTROMIGRATION, OXIDE AND MOS

Invited Paper
Influence of pulsed DC current stress on electromigration results in AlCu interconnections; analysis of thermal and healing effects 773
L. ARNAUD, G. REIMBOLD, P. WALTZ

Modelling hot-carrier degradation of LDD NMOSFETs by using a high-resolution measurement technique 785
R. DREESEN, K. CROES, J. MANCA, W. DE CEUNINCK, L. DE SCHEPPER, A. PERGOOT, G. GROESENEKEN

Model for the oxide thickness dependence of SILC generation based on anode hole injection process 791
C. JAHAN, S. BRUYÈRE, G. GHIBAUDO, E. VINCENT, K. BARLA

Study of stress induced leakage current by using high resolution measurements 797
B. DE SALVO, G. GHIBAUDO, G. PANANAKAKIS, B. GUILLAUMOT, G. REIMBOLD

Modelling of the temperature and electric field dependence of substrate/gate current SILC with an elastic resonant trap assisted tunnelling mechanism 803
P. RIESS, G. GHIBAUDO, G. PANANAKAKIS

Temperature dependence of hot carrier induced MOSFET degradation at low gate bias 809
S.H. HONG, S.M. NAM, B.O. YUN, B.J. LEE, C.G. YU, J.T. PARK

Temperature acceleration of breakdown and quasi-breakdown phenomena in ultra-thin oxides 815
S. BRUYÈRE, D. ROY, E. VINCENT, G. GHIBAUDO

Trapping mechanisms in negative bias temperature stressed p-MOSFETs 821
C. SCHLÜNDER, R. BREDERLOW, P. WIECZOREK, C. DAHL, J. HOLZ, M. RÖHNER, S. KESSEL, V. HEROLD, K. GOSER, W. WEBER, R. THEWES

Depassivation of latent plasma damage in pMOS devices 827
L. PANTISANO, A. PACCAGNELLA, P. COLOMBO, M.G. VALENTINI

Extended SPICE-like model accounting for layout effects on snapback phenomenon during ESD events 833
P. SALOME, C. RICHIER, S. ESSAIFI, C. LEROUX, I. ZAZA, A. JUGE, P. MORTINI

HBM and TLP ESD robustness in smart-power protection structures 839
S. SANTIROSI, G. MENEGHESSO, E. NOVARINI, C. CONTIERO, E. ZANONI

Wafer mapping of ESD performance 845
J.C. REINER, H.-U. SCHRÖDER, M. BENDER

Ageing of laser crystallized and unhydrogenated polysilicon thin film transistors 851
A. RAHAL, T. MOHAMMED-BRAHIM, H. TOUTAH, B. TALA-IGHIL, Y. HELEN, C. PRAT, F. RAOULT

A stochastic approach to failure analysis in electromigration phenomena 857
C. PENNETTA, L. REGGIANI, G. TREFÁN, F. FANTINI, I. DE MUNARI, A. SCORZONI

New latchup mechanism in complementary bipolar power ICs triggered by backside die attach glue 863
J.A. VAN DER POL, J.-P.F. HUIJSER, R.B.H. BASTEN

Hot-hole-induced interface states build-up on deep-submicrometer LDD nMOSFETs 869
J.M. RAFÍ, F. CAMPABADAL

Transient induced latch-up triggered by very fast pulses 875
D. BONFERT, H. GIESER

Extraction and evolution of Fowler–Nordheim tunneling parameters of thin gate oxides under EEPROM-like dynamic degradation 879
S. CROCI, J.M. VOISIN, C. PLOSSU, C. RAYNAUD, J.L. AUTRAN, P. BOIVIN, J.M. MIRABEL

Leakage current variation during two different modes of electrical stressing in undoped hydrogenated n-channel polysilicon thin film transistors (TFTs) 885
F.V. FARMAKIS, J. BRINI, G. KAMARINOS, C.A. DIMITRIADIS, V.K. GUEORGUIEV, T.E. IVANOV

Model-independent determination of the degradation dynamics of thin SiO_2 films 891
R. RODRÍGUEZ, M. NAFRÍA, E. MIRANDA, J. SUÑÉ, X. AYMERICH

Reliability improvement of EEPROM by using WSi_2 polycide gate 897
K. OGIER-MONNIER, P. BOIVIN, O. BONNAUD

Mercury-probe characterisation of soft breakdown: effect of oxide thickness and measurement set-up 903
A. CACCIATO, S. EVSEEV

TOPIC C: ELECTRON AND OPTICAL BEAM TESTING

Invited Paper
Advanced failure detection techniques in deep submicron CMOS integrated circuits 909
A. RUBIO, J. ALTET, D. MATEO

Fault localisation in ICs by goniometric laser probing of thermal induced surface waves 919
S. DILHAIRE, J. ALTET, S. JOREZ, E. SCHAUB, A. RUBIO, W. CLAEYS

Laser interferometric method for ns-time scale thermal mapping of smart power ESD protection devices during ESD stress 925
C. FÜRBÖCK, M. LITZENBERGER, D. POGANY, E. GORNIK, N. SELIGER, T. MÜLLER-LYNCH, M. STECHER, H. GOSSNER, W. WERNER

Validation of radiation hardened designs by pulsed laser testing and SPICE analysis 931
V. POUGET, D. LEWIS, H. LAPUYADE, R. BRIAND, P. FOUILLAT, L. SARGER, M.-C. CALVET

Front- and backside investigations of thermal and electronic properties of semiconducting devices 937
G.B.M. FIEGE, W. SCHADE, M. PALANIAPPAN, V. NG, J.C.H. PHANG, L.J. BALK

A new AFM-based tool for testing dielectric quality and reliability on a nanometer scale 941
A. OLBRICH, B. EBERSBERGER, C. BOIT, J. VANCEA, H. HOFFMANN

Sub-surface analyses of defects in integrated devices by scanning probe acoustic microscopy 947
R.M. CRAMER, V. BILETZKI, P. LEPIDIS, L.J. BALK

Quantitative high frequency-electric force microscope testing of monolithic microwave integrated circuits at 20 GHz 951
V. WITTPAHL, C. NEY, U. BEHNKE, W. MERTIN, E. KUBALEK

Laser beam backside probing of CMOS integrated circuits 957
S. KASAPI, C.-C. TSAO, K. WILSHER, W. LO, S. SOMANI

Electron beam testing of FPGA circuits 963
R. DESPLATS, P. PERDU, B. BENTEO, A. GRANGY

Voltage contrast measurements on sub-micrometer structures with an electric force microscope based test system 969
U. BEHNKE, B. WAND, W. MERTIN, E. KUBALEK

A new bifunctional topography and current probe for scanning force microscope testing of integrated circuits 975
S. BAE, K. SCHIEMANN, W. MERTIN, E. KUBALEK, M. MAYWALD

Optical method for the measurement of the thermomechanical behaviour of electronic devices 981
S. DILHAIRE, S. JOREZ, A. CORNET, E. SCHAUB, W. CLAEYS

TOPIC D: ADVANCED FAILURE ANALYSIS TECHNIQUES

Cross-section analysis of electric devices by scanning capacitance microscope 987
Y. TAKASAKI, T. YAMAMOTO

TIVA and SEI developments for enhanced front and backside interconnection failure analysis 991
E.I. COLE JR., P. TANGYUNYONG, D.A. BENSON, D.L. BARTON

Enhancing IC-repairs by combining laser direct-writing of Cu and FIB techniques 997
J. REMES, H. MOILANEN, S. LEPPÄVUORI

FIB voltage contrast measurement for enhanced circuit repairs 1003
R. DESPLATS, B. BENTEO, P. PERDU

Improved SRAM failure diagnosis for process monitoring via current signature analysis 1009
M. SCHIENLE, T. ZANON, D. SCHMITT-LANDSIEDEL

Failure analysis method by using different wavelengths lasers and its application 1015
S. ITO, Y. TANDO

Defect localization using voltage contrast I_{DDQ} testing 1021
P. PERDU, R. DESPLATS

2D physical simulation of degradation on transistors induced by FIB exposure of dielectric passivation 1027
J. BENBRIK, G. ROLLAND, D. MEUNIER, B. BENTEO, N. LABAT, C. MANEUX, Y. DANTO

TOPIC E: RELIABILITY OF COMPOUND SEMICONDUCTORS

Invited Paper
Physics of degradation in GaAs-based heterojunction bipolar transistors 1033
T. HENDERSON

Gold removal in failure analysis of GaAs-based laser diodes 1043
M. VANZI, A. BONFIGLIO, P. SALARIS, P. DEPLANO, E.F. TROGU, A. SERPE, G. SALMINI, R. DE PALO

Evaluation of P-HEMT MMIC technology PH25 for space applications 1049
P. HUGUET, P. AUXEMERY, G. PATAUT, F. GARAT

Degradation of AlGaAs/GaAs power HFETs under on-state and off-state breakdown conditions 1055
D. DIECI, G. SOZZI, R. MENOZZI, C. LANZIERI, A. CETRONIO, C. CANALI

Effects of RF life-test on LF electrical parameters of GaAs power MESFETs 1061
N. SAYSSET-MALBERT, B. LAMBERT, C. MANEUX, N. LABAT, A. TOUBOUL, Y. DANTO, L.K.J. VANDAMME, P. HUGUET, P. AUXEMERY, F. GARAT

A simpler method for life-testing laser diodes 1067
M. VANZI, G. MARTINES, A. BONFIGLIO, M. LICHERI, R. D'ARCO, G. SALMINI, R. DE PALO

Cathodoluminescence from hot electron stressed InP HEMTs 1073
P. COVA, G. MENEGHESSO, G. SALVIATI, E. ZANONI

TOPIC F: PACKAGING, ASSEMBLIES AND MICROSYSTEMS

Invited Paper
Impact of FEM simulation on reliability improvement of packaging 1079
K. WEIDE

1/f noise in conductive adhesive bonds under mechanical stress as a sensitive and fast diagnostic tool for reliability assessment 1089
L.K.J. VANDAMME, M.G. PERICHAUD, E. NOGUERA, Y. DANTO, U. BEHNER

Localization of defects in die-attach assembly by continuous wavelet transform using scanning acoustic microscopy 1095
L. BECHOU, L. ANGRISIANI, Y. OUSTEN, D. DALLET, H. LEVI, P. DAPONTE, Y. DANTO

Quality and mechanical reliability assessment of wafer-bonded micromechanical components 1103
M. PETZOLD, J. BAGDAHN, D. KATZER

Contact resistance anomalies of vias before breakdown in accelerated current life tests 1109
W.L.F. GÖLZ

TOPIC G: POWER DEVICES

Invited Paper
Physical limits and lifetime limitations of semiconductor devices at high temperatures 1113
W. WONDRAK

Invited Paper
Device reliability and robust power converter development 1121
N. KESKAR, M. TRIVEDI, K. SHENAI

Lifetime extrapolation for IGBT modules under realistic operation conditions 1131
M. CIAPPA, P. MALBERTI, W. FICHTNER, P. COVA, L. CATTANI, F. FANTINI

Long term reliability testing of HV-IGBT modules in worst case traction operation 1137
L. FRATELLI, B. CASCONE, G. GIANNINI, G. BUSATTO

Damage analysis in smart-power technology electrostatic discharge (ESD) protection devices 1143
D. POGANY, N. SELIGER, M. LITZENBERGER, H. GOSSNER, M. STECHER, T. MÜLLER-LYNCH, W. WERNER, E. GORNIK

Thermal characterization of power devices by scanning thermal microscopy techniques 1149
G.B.M. FIEGE, F.-J. NIEDERNOSTHEIDE, H.-J. SCHULZE, R. BARTHELMESS, L.J. BALK

Reliability and lifetime evaluation of different wire bonding technologies for high power IGBT modules 1153
A. HAMIDI, N. BECK, K. THOMAS, E. HERR

Reliability of AlN substrates and their solder joints in IGBT power modules 1159
G. MITIC, R. BEINERT, P. KLOFAC, H.J. SCHULTZ, G. LEFRANC

Power cycling on press-pack IGBTs: measurements and thermomechanical simulation 1165
P. COVA, G. NICOLETTO, A. PIRONDI, M. PORTESINE, M. PASQUALETTI

Author Index I

NUMBER 8

1171 In memoriam

Introductory Invited Papers

F. J. García Sánchez, A. Ortiz-Conde and J. J. Liou 1173 On the extraction of the source and drain series resistances of MOSFETs

E. Atanassova 1185 Thin RF sputtered and thermal Ta_2O_5 on Si for high density DRAM application

Research Papers

D. L. Barton, M. Osinski, P. Perlin, P. G. Eliseev and J. Lee 1219 Single-quantum well InGaN green light emitting diode degradation under high electrical stress

S. L. Miller, M. S. Rodgers, G. La Vigne, J. J. Sniegowski, P. Clews, D. M. Tanner and K. A. Peterson 1229 Failure modes in surface micromachined microelectromechanical actuation systems

M. Vellvehi, X. Jordà, D. Flores, P. Godignon, J. Rebollo and J. Millán 1239 Electrical characteristics of advanced lateral insulated-gate bipolar transistor structures at 77 K

N. V. Demarina and S. V. Obolensky 1247 Modeling of ionizing irradiation influence on Schottky-gate field-effect transistor

P. M. Fabis 1265 Reliability of radio frequency/microwave power packages: the effects of component materials and assembly processes

P. M. Fabis 1275 Material property, compatibility, and reliability issues in diamond-enhanced, GaAs-based plastic packages

Research Notes

Y. Dai and J. Xu 1293 Analog circuit fault diagnosis based on noise measurement

G. Xiao, J. Lee, J. J. Liou and A. Ortiz-Conde 1299 Incomplete ionization in a semiconductor and its implications to device modeling

1305 Calendar of forthcoming events

NUMBER 9

Introductory Invited Papers

D. S. Ang and C. H. Ling 1311 On the time-dependent degradation of LDD n-MOSFETs under hot-carrier stress

D. M. Fleetwood, R. A. Reber Jr, L. C. Riewe and P. S. Winokur 1323 Thermally stimulated current in SiO_2

Research Papers

S. Zhang, J. De Baets and A. Van Calster 1337 A two-layer high density printed circuit board and its reliability

S. Haque, W. A. Stinnett, D. J. Nelson and G.-Q. Lu 1343 Thermal management of power electronics modules packaged by a stacked-plate technique

Z. P. Wang, Y. M. Tan and K. M. Chua 1351 Board level reliability assessment of chip scale packages

L. Forbes, M. S. Choi and W. Cao 1357 $1/f$ noise due to temperature fluctuations in heat conduction in bipolar transistors

M. Amagai 1365 Characterization of chip scale packaging materials

J.-H. Tsai 1379 Functional AlGaAs/GaAs heterostructure-emitter bipolar transistor with a pseudomorphic InGaAs/GaAs quantum-well base

M. Klein, H. Oppermann, R. Kalicki, R. Aschenbrenner and H. Reichl 1389 Single chip bumping and reliability for flip chip processes

J. Keating 1399 Transition of MCM-C applications to MCM-L using rigid flex substrates

Research Notes

G. Harsányi 1407 Irregular effect of chloride impurities on migration failure reliability: contradictions or understandable?

Z. Yang 1413 Maximum likelihood predictive densities for the inverse Gaussian distribution with applications to reliability and lifetime predictions

NUMBER 10

Introductory Invited Papers

K. Kimseng, M. Hoit, N. Tiwari and M. Pecht 1423 Physics-of-failure assessment of a cruise control module

R. Degraeve, B. Kaczer and G. Groeseneken 1445 Degradation and breakdown in thin oxide layers: mechanisms, models and reliability prediction

Research Papers

M. Meinhardt, V. Leonavicius, J. Flannery and S. C. Ó Mathúna 1461 Impact of power electronics packaging on the reliability of grid connected photovoltaic converters for outdoor applications

A. A. Ismaeel, R. Bhatnagar and R. Mathew 1473 Modification of scheduled data flow graph for on-line testability

C. A. Betty, K. G. Girija and R. Lal	1485	Relaxation of operational amplifier parameters after pulsed electron beam irradiation
G. Golan, E. Rabinovich, A. Inberg, A. Axelevitch, M. Oksman, Y. Rosenwaks, A. Kozlovsky, P. G. Rancoita, M. Rattaggi, A. Seidman and N. Croitoru	1497	Dislocations structure investigation in neutron irradiated silicon detectors using AFM and microhardness measurements
		Research Note
Á. Nemcsics, I. Mojzes and L. Dobos	1505	Investigation of morphology and fractal behaviour on compound semiconductor surface after electrochemical layer removal
	1511	Book reviews

NUMBER 11

SPECIAL SECTION: PAPERS PRESENTED AT THE 1998 SYMPOSIUM ON ELECTRICAL OVERSTRESS/ELECTROSTATIC DISCHARGE (EOS/ESD)

S. H. Voldman	1519	Preface
W. R. Anderson and D. B. Krakauer	1521	ESD protection for mixed-voltage *I/O* using NMOS transistors stacked in a cascode configuration
M. Chaine, K. Verhaege, L. Avery, M. Kelly, H. Gieser, K. Bock, L. G. Henry, T. Meuse, T. Brodbeck and J. Barth	1531	Investigation into socketed CDM (SDM) tester parasitics
H. Wolf, H. Gieser and W. Stadler	1541	Bipolar model extension for MOS transistors considering gate coupling effects in the HBM ESD domain
C. Russ, K. Bock, M. Rasras, I. De Wolf, G. Groeseneken and H. E. Maes	1551	Non-uniform triggering of gg-nMOSt investigated by combined emission microscopy and transmission line pulsing
A. D. Stricker, S. Mettler, H. Wolf, M. Mergens, W. Wilkening, H. Gieser and W. Fichtner	1563	Characterization and optimization of a bipolar ESD-device by measurements and simulations
P. Salome, C. Leroux, P. Crevel and J. P. Chante	1579	Investigations on the thermal behavior of interconnects under ESD transients using a simplified thermal RC network

SPECIAL SECTION: CURRENT ISSUES IN METAL MIGRATION

T. J. Mouthaan and H. Onoda	1593	Guest Editorial
J. R. Lloyd, J. Clemens and R. Snede	1595	Copper metallization reliability
A. Witvrouw, H. Bender, Ph. Roussel and K. Maex	1603	Modeling and microstructural characterization of incubation, time-dependent drift and saturation during electromigration in Al–Si–Cu stripes
J. D'Haen, P. Cosemans, J. V. Manca, G. Lekens, T. Martens, W. De Ceuninck, M. D'Olieslaeger, L. De Schepper and K. Maex	1617	Dynamics of electromigration induced void/hillock growth and precipitation/dissolution of addition elements studied by in-situ scanning electron microscopy resistance measurements
M. Hasunuma, H. Toyoda and H. Kaneko	1631	Electromigration induced aluminum atom migration retarding by grain boundary structure stabilization and copper doping
A. Scorzoni, I. De Munari, M. Impronta and N. Kelaidis	1647	Early electromigration effects and early resistance changes

Review Paper
J. Van Olmen, J. V. Manca, W. De Ceuninck, L. De Schepper, V. D'Haeger, A. Witvrouw, K. Maex, B. Vandevelde, E. Beyne and L. Tielemans 1657 The kinetics of the early stages of electromigration and concurrent temperature induced processes in thin film metallisations studied by means of an in-situ high resolution resistometric technique

W. Schoenmaker and V. Petrescu 1667 Modeling electromigration as a fluid–gas system

J. Guo, B. K. Jones and G. Trefan 1677 The excess noise in integrated circuit interconnects before and after electromigration damage

C. Ciofi, V. Dattilo, B. Neri, S. Foley and A. Mathewson 1691 Long term noise measurements and median time to failure test for the characterization of electromigration in metal lines

M. Kageyama, K. Hashimoto and H. Onoda 1697 Electromigration performance of Al–Si–Cu filled vias with titanium glue layer

S. Foley, J. Molyneaux and A. Mathewson 1707 An evaluation of fast wafer level test methods for interconnect reliability control

1715 Calendar of forthcoming events

NUMBER 12

SPECIAL ISSUE
RELIABILITY OF COMPOUND SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS

F. Fantini, J. J. Liou and M. Fukuda 1721 Guest Editorial

Review Paper
S. Kayali 1723 Reliability of compound semiconductor devices for space applications

Review Paper
J. Würfl, V. Abrosimova, J. Hilsenbeck, E. Nebauer, W. Rieger and G. Tränkle 1737 Reliability considerations of III-nitride microelectronic devices

G. Meneghesso, G. Massari, D. Buttari, A. Bortoletto, M. Maretto and E. Zanoni 1759 DC and pulsed measurements of on-state breakdown voltage in GaAs MESFETs and InP-based HEMTs

M. Nawaz, H. Zirath, E. Choumas, S. H. M. Persson, A. Jasik and W. Strupinski 1765 Hot electron degradation effects in 0.14 μm AlInAs/GaInAs/InP HEMTs

L. Forbes, K. T. Yan and S. S. Taylor 1773 A model for the channel noise of MESFETs including hot electron effects

Y. K. Fukai, K. Yamasaki and K. Nishimura 1787 Threshold voltage shift in 0.1 μm self-aligned-gate GaAs MESFETs under bias stress and related degradation of ultra-high-speed digital ICs

J. K. Mun, J. W. Lim, J. J. Lee and J. W. Yang 1793 Degradation of d.c. parameters in enhancement mode WN_x self-aligned gate GaAs MESFETs under high temperature stress

Review Paper
D. Pavlidis 1801 Reliability characteristics of GaAs and InP-based heterojunction bipolar transistors

A. A. Rezazadeh, S. A. Bashar, H. Sheng, F. A. Amin, A. H. Khalid, M. Sotoodeh, M. A. Crouch, L. Cattani, F. Fantini and J. J. Liou 1809 Reliability investigation of InGaP/GaAs HBTs under current and temperature stress

C.-K. Song and P.-J. Choi 1817 Effects of InGaP heteropassivation on reliability of GaAs HBTs

M. Borgarino, R. Plana, S. Delage, F. Fantini and J. Graffeuil 1823 On the short and long term degradation of GaInP/GaAs heterojunction bipolar transistors

C. R. Bolognesi, N. Matine, X. G. Xu, G. Soerensen and S. P. Watkins 1833 $InP/GaAs_{0.51}Sb_{0.49}/InP$ fully self-aligned double heterojunction bipolar transistors with a C-doped base: a preliminary reliability study

Review Paper

O. Ueda 1839 Reliability issues in III–V compound semiconductor devices: optical devices and GaAs-based HBTs

H. Mawatari, M. Fukuda and Y. Tohmori 1857 Degradation behavior of the active region and passive region in buried heterostructure (BH) distributed Bragg reflector (DBR) lasers

H. C. Neitzert and A. Piccirillo 1863 Sensitivity of multimode bidirectional optoelectronic modules to electrostatic discharges

Review Paper

K. F. Brennan, J. Haralson II, J. W. Parks Jr and A. Salem 1873 Review of reliability issues of metal-semiconductor-metal and avalanche photodiode photonic detectors

1885 Contents of Volume 39

1899 Author Index to Volume 39